# Quadrupole Moments of Wobbling Excitations in $^{163}$Lu

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A triaxial nucleus with three distinct moments of inertia can possess a unique mode of excitation, called the wobbling mode [1]. This motion is characterized by a family of bands with very similar intrinsic structure. The bands can be described in terms of phonon excitations, and each band is assigned a "wobbling phonon" number. As a consequence of the collective nature of the wobbling excitation, fast inter-band transitions can compete with the in-band transitions. Such transitions have been observed in odd-even Lu isotopes and provide firm evidence for this new mode of excitation.

In the case of $^{163}$Lu, the three lowest-lying bands built on triaxial, strongly deformed configurations, called TSD1-TSD3, have been identified as the 0-, 1-, and 2-phonon wobbling bands [2], based on the electromagnetic characteristics of the transitions connecting the bands. So far only the average quadrupole moment for the 0-phonon band has been measured, and more detailed lifetime measurements were clearly needed to support the wobbling picture.

An experiment was carried out with Gammasphere using the $^{123}$Sb($^{44}$Ca,4n)$^{163}$Lu reaction at 190 MeV. The target of 1 mg/cm$^2$ had a 12 mg/cm$^2$ gold backing and lifetimes were obtained using the Doppler shift attenuation method (DSAM). This experiment provides the first measurement of the quadrupole moments in an excited wobbling band.

Preliminary results for the measured fractional Doppler shifts, F($\tau$), for transitions in TSD1 and TSD2 are shown in the lower part of Fig. 1. While the transitions are equally fast for both bands at the highest spins, the transitions of TSD2 appear faster at lower spins because of the competing inter-band transitions. This becomes even more evident in an analysis of the individual lineshapes. Since the branching ratios are known, this effect can be corrected and one obtains the in-band quadrupole moments $Q_t$ shown in the upper part of Fig. 1.

These results show that bands TSD1 and TSD2 have indeed a very similar $Q_t$ as required by wobbling interpretation. These data also gave the measurement of absolute B(E2) values for both in-band and out-of-band transitions. Previously, only their ratio was known from the branching ratios. Moreover, the quadrupole moments of both bands show a decreasing trend towards higher spin. The fact that both bands exhibit the same change in $Q_t$ further strengthens the argument that they are based on the same intrinsic structure. The varying $Q_t$ implies that either the $\beta$ or $\gamma$ deformation (or both) is changing and will these data on the intra- and inter-band transitions will provide a stringent test of the wobbling picture.

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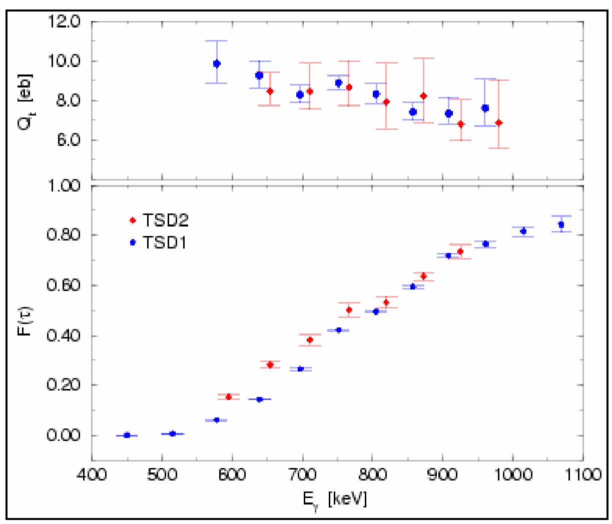


Fig. 1. Fractional Doppler shifts and quadrupole moments for TSD1 and TSD2 in $^{163}$Lu